

IV.—ON LINNARSSON'S RECENT DISCOVERIES IN SWEDISH GEOLOGY.

By CHARLES LAPWORTH, F.G.S., etc.

(PART II.)

(Continued from p. 37.)

On the Graptolites of Gothland (Om Gotlands Graptolither). By G. Linnarsson. Ofv. af. Kongl. Vetens. Akad. Förh.; 1879, No. 5, pp. 12.

The island of Gothland, so rich in all other Silurian fossils, is remarkably poor in Graptolites. Angelin and Lindström simply noted the fact of their presence, but did not attempt their identification. At Dr. Lindström's suggestion, Mr. G. Linnarsson here describes and figures the two species that have been procured from these strata, from examples now in the Riks-Musei of Stockholm.

The commoner form in the Gothland beds is the familiar species *Monograptus priodon*, Bronn. The author gives a careful description of this form, principally from the Gothland examples, which appear to be in a good state of preservation. He points out that, as in the examples from Dalarne, Westrogothia, and Britain, the polypary in this species is perfectly straight throughout, except near the proximal extremity, where it is slightly recurved. He admits, however, with characteristic candour, that this latter feature gives colour to Barrande's reference of the Bohemian sub-spiral forms to this species. I would here remark that the beautifully curved example figured by Barrande (*Grapt. de Bohême*, plate i. figs. 1, 2, 4, 5, 6, 7, 8, 9) is the only one of those placed by him under *M. priodon*, which agrees strictly with our British species in the form and relations of the thecae. The examples illustrated in his figures 2, and 10 to 14, if they are correctly figured (and no one who has honestly studied Barrande's works can doubt this), cannot be *M. priodon*, as I understand it, but must belong to some species as yet undescribed. I have myself occasionally detected specimens not unlike Barrande's fig. 1, but they are excessively rare, and, like his, have the appearance of having been unnaturally distorted.

Linnarsson points out very correctly that *M. priodon* is, perhaps, more closely allied to *Monogr. lobiferus*, McCoy, than to the typical form of *M. Halli*, Barr., near which I have referred it. The latter is, however, a most variable form, and many of our extreme British varieties have been generally referred to *Monogr. priodon*.

M. Ludensis, Murch., and *M. Clintonensis*, Hall, are placed by the author among the synonyms of *M. priodon*, but he is careful to note that in the present state of our knowledge they are most conveniently regarded as distinct. That their individual distinctness will eventually be placed beyond question appears to me to be quite clear. With regard to *M. Ludensis*, quoted by Murchison, from the Lower Ludlow beds of Siluria, neither Mr. Hopkinson nor myself, nor

indeed any of the local geologists, have ever been able to detect a fragment of *M. priodon* in the Lower Ludlow rocks. A glance at Sowerby's drawing of the species in question (Siluria, plate xviii. fig. 1a), shows that it was made from a partly-decorticated specimen. His magnified drawing, fig. 1a, certainly gives the general impression that the thecae were similar in form to those of *M. priodon*. But it is impossible to reconcile their appearance with that of the thecae on the adult part of the polypary on fig. 1, which are like those of my *M. M'Coyii*. If the examples illustrated on fig. 2 are the same species, the question is settled, for these are wholly distinct from those of *M. priodon*. As regards *M. Clintonensis*, Hall, the differences are so marked that the question of identity may soon be disposed of. In *M. Clintonensis*, Hall, the polypary is slender; it has a ventral curvature; its proximal thecae are those of the proximal end of *M. Sedgwicki*, Portk. (var. *Heuberti*, Geinitz); its distal thecae alone resemble those of *M. priodon*, and they are wholly destitute of anything like overlap. In *M. priodon*, on the other hand, the polypary rapidly becomes stout and thick; it is either quite straight, or it has a dorsal curvature only; its proximal thecae point in the direction of those of *M. lobiferus*, M'Coy; and in the adult thecae there is invariably an amount of overlap, equal to at least half the length of the thecae. Of course, the value of these criteria vary in the minds of palaeontologists in direct proportion to their ideas of what amount of difference ought to separate allied species; but I would diffidently submit the opinion, that if these three forms had been *Trilobites*, Mr. Linnarsson would never have been aware of the possible existence of this difficulty.

The second form noticed is *Retiolites Geinitzianus*, Barr. This is also illustrated with several fine figures and described with great care. From a comparison of specimens collected, not only from Gothland, but also from the mainland of Sweden, and from Norway, the author finds the transverse section of the polypary to have been an oval, truncated at both ends. He is unable to detect anything like true partition-walls—the coarse filaments generally so called apparently forming an integral portion of the filiform framework. The appearances point rather in the direction of the theory that the whole interior of the polypary formed a single undivided chamber; a theory which, however, he does not advocate, as it is discordant with the opinions of those palaeontologists who have already carefully examined the species. In a specimen in relief, from Norway, he finds a sub-median network, like that upon the exterior surface, traversing the body of the polypary longitudinally. There is no trace of a virgula in the Gothland specimen; but in examples from the mainland, a longitudinal fibre is frequently visible; but whether this is actually a true virgula, or whether, as Hall and myself have suggested, there are actually two of these median threads, one straight and the other zig-zag, there is in the Swedish specimens no evidence to show. The mouths of the thecae are figured as octagonal, but there is no trace of ornamentation around their apertures.

These Graptolites are found in the strata of both of the two main

divisions of the Gothland Silurian—the so-called Wisby Group and the Middle Gothland Group. *Retiolites Geinitzianus* has been detected by the author only in the Wisby Group; *Monograptus priodon* occurs in both formations.

On the Fauna of the Exsulans or Coronatus Limestone of Sweden (Om Faunen in Kalken med *Conocoryphe exsulans*; *Coronatus-Kalken*). By G. Linnarsson. pp. 28, 3 plates of figures. Stockholm, 1879.

At Kiviks Esperöd in Scania, where the horizontal Cambrian rocks are washed bare by the waters of the Baltic, Dr. Nathorst discovered, several years ago, a remarkable fossiliferous limestone undoubtedly belonging to the Primordial Zone of Barrande—containing a Trilobite-fauna, almost wholly new to science. In his description of the fauna of this limestone he enumerated *Paradoxides Tessini*, *Paradox. Hicksi*, *Solenopleura* and *Conocoryphe* (Geol. Fören. För. 1877, p. 264). The commonest fossil he referred to the Spanish species *Conocephalites coronatus* of Barrande and Verneuil, and gave the limestone the distinctive title of Coronatus-Limestone. It now appears, however, that Nathorst was in error in referring the Swedish fossil to *C. coronatus*; for according to Linnarsson the two forms are quite distinct. Nathorst's title for these beds is thus no longer suitable, and Linnarsson replaces it with the name *Exsulans* Limestone, after the new title he here assigns to the characteristic fossil.

At Kiviks Esperöd the Cambrian beds commence with the usual sandstones. These are overlaid by greywackes, undoubtedly belonging to the Zone of *Olenellus* (*Paradoxides*) *Kjerulfi*. These support a grey clay shale, underlying a band of nodular limestone. In the shales a few fossils are present—*Paradoxides* sp., *Conocoryphe Dalmani*, Ang., *Acrothele intermedia*, Linnrs. Next follows the so-called Coronatus-Limestone, which forms the subject of this paper. It is here a hard, grey, slightly bituminous limestone. Above it follows, after an insignificant hiatus, another limestone, the fossils of which allow us to parallel it without doubt with the well-known Andraruum-Limestone of Angelin, or the Zone of *Paradoxides Forchammeri* of Linnarsson.

Similar fossils to those present in the Coronatus Limestone of Kiviks Esperöd were detected in 1870 by Dr. Nathorst in loose stones near Sandby. At Gislof, where bedded Cambrians are visible, Herr von Schmalenzee, who completed the survey of Kiviks Esperöd, detected the fossils of the Coronatus zone in abundance. Finally, the same indefatigable investigator has discovered the same fauna in the classical locality of Andraruum, not only in loose blocks, but also *in situ* from beds immediately below the strata of the zone of *Paradoxides Tessini*.

Linnarsson rightly points out that the fossils of the *Coronatus* or *Exsulans* Limestone are most distinctly allied to those of his zone of *Paradoxides Tessini*: but if we have regard to Schmalenzee's discovery at Andraruum, they may conveniently be regarded as marking a new horizon or sub-zone, immediately below it in the

succession. The following are the commoner fossils of this new horizon :—

Paradoxides Tessini, Brongn.
— — — *Hicksii*, Salt.
var. palpebrosus.
Liostracus aculeatus, Ang.
Solenoplectron parva, n. sp.
Conocoryphe exsulans, n. sp.
= *C. coronatus* of Nathorst.
Conocoryphe Dalmani, Ang.
— — — *tenuinincta*, n. sp.
— — — *impressa*, n. sp.

Agnostus gibbus, Linnrs.
— — — *fallax*, Linnrs.
— — — *fissus*, Lundgr. MS.
Metoptoma Barrandei, n. sp.
Hyolithus, sp. ind.
Lingulella, sp. ind.
Acrothele intermedia, n. sp.
Obotella sagittatis, Salt.

Of the above species, at least four—*Paradox. Tessini*, *Liostr. aculeatus*, *Agnostus gibbus*, and *Agnostus fallax*—have been collected from the zone of *Paradoxides Tessini*, under its most typical aspect, not only in Scania, but in Westrogothia, Nerike and in Oland. On the other hand, not one has certainly been recognized in the zones of *Paradoxides Kjerulfi* and *Paradoxides Forchammeri*, which lie respectively above and below the zone of *Paradox. Tessini*.

The fossils of the Coronatus-Limestone are almost wholly peculiar to Scandinavia. A few of those figured by Barrande from his Etage C. are somewhat similar, but are not actually identical. As yet it is impossible to institute a comparison between the fauna of the Coronatus-beds and that of any of the presently accepted subdivisions of the British Cambrian, from the fact that, owing to the indifferent state of preservation of the British species, it is as yet impossible to say which of them are identical with the Swedish forms. From the general aspect of the fauna, however, it is suggested that the systematic place of the Coronatus-Limestone is between the Menevian and Longmynd Groups, as these are presently defined by Dr. Hicks.

The whole of the known species of the Coronatus-Limestone are described in full by the author, and illustrated in three very beautiful lithographic plates. Under his description of *Acrothele intermedia*, Linnarsson replies briefly to the strictures of Ford, more especially with reference to the implication that *Acrothele* was ignorantly founded upon the heterogeneous elements of the dorsal shell of *Lingula* and the operculum of *Hyolithus*; and points out extra-Swedish examples of his genus.

The strikingly Primordial character of the rich fauna of this previously overlooked Coronatus zone is apparent at a glance, and forms another of the abundant recent indications that the underrated Cambrian system, absorbed into the Silurian by the omnivorous Murchisonians and despised and rejected by the discontented followers of Sedgwick, is certain to prove itself as important in the geological series as the better understood, and therefore more highly estimated systems that succeeded it.

Like all Mr. Linnarsson's papers, this bears upon every page the marks of keen research and of modest caution, combined with deep palaeontological knowledge, and it forms a most valuable contribution to the literature of the Cambrian rocks.